One brief, shining moment? The impact of neo-liberalism on science curriculum in the compulsory years of schooling.

Abstract

The past twenty years or so have seen ongoing concern for the nature of science education in the Anglophone developed world. A particular focus of this concern has been the need to find new ways to frame science curricula that will engage students, yet it is proving difficult to achieve this goal. In this paper I argue that the impact on science curriculum of a societal shift to neo-liberalism and an attendant policy shift to outcomes-based education should be explicitly acknowledged; further, that the forms of curriculum that emerge from neo-liberalism are unlikely to provide the engaging and inclusive science education needed today. To illustrate the impact of the neo-liberal societal shift on science curriculum I compare an exemplary, inclusive and innovative science curriculum document from the 1980s with its outcomes-based successor from the 1990s. I show that in this case the shift to the outcomes-based form significantly restricted the possibilities for framing science education to respond to the local community, restricting a vision of science as social institution; further, it framed each learner as an individual to the exclusion of community while reducing options for framing learning to meet individual needs. I argue that it is important for the future disciplinary well-being of science, and for the well-being of society in the broad, that both science and its scientists be seen as socially located. Science curriculum documents must initiate and support this perspective.

Dissatisfaction with Science curriculum in the compulsory years of school

The past two or three decades have seen ongoing concern for science education in the compulsory years of schooling in the developed world. Student engagement with science
has been a source of concern: for example Fensham speaks of ‘the great contemporary problem facing science education, namely, the disengagement of students with science’ (2004, p. 1), citing concern from Ireland, The Netherlands, Norway and Finland, Australia, India, Germany, USA, France and England. Tytler, writing about Australia, uses the language of ‘a crisis’ (2007, p. 3) to report a diminishing proportion of science students in the post-compulsory years, an attendant shortage of skilled science professionals in the workplace and considerable evidence of student disenchantment with the now-compulsory science in the middle years. In England and Wales the number of young people obtaining physics or chemistry qualifications at Advanced level is falling despite a background trend of steadily growing numbers in non-science subjects (Wellington, 2001).

Aikenhead, in a survey of international research studies, identifies four failures of science education today: declining student enrolments either due to students’ disenchantment with school science or due to students’ cultural self-identities conflicting with their perceptions of science and technology; forms of discrimination and cultural alienation; dishonest and mythical images about science and scientists conveyed by school science; and the difficulties most students face in learning science. He frames these as ‘major failures of the traditional science curriculum’ (Aikenhead, 2006, p. 25), thereby locating the problem within the sphere of curriculum.

Concern is not new: research on attitudes to science shows that student disenchantment can be documented at least as far back as the 1970s (Wellington, 2001). Increasingly, throughout this period, voices from the developing international science education community have called for a re-think or re-imagining of science education (Fensham, 1985, 2000, 2002, 2004;
The context and desired outcomes of the critiques have changed over time.

In the immediate postwar period, in the Anglophone developed world – the USA, Canada, the UK and Australia - calls for change were motivated by a perceived need to capture those students seen as the brightest and best (in the terms of the times) for science. The courses that were developed in response (Physical Science Study Committee, 1960 is the first example) were designed for only a few students who were predisposed to see science as an intellectual challenge; the courses presented science as ‘a ‘pure’ enterprise, not embedded in a social or cultural context’ (Gunstone, 2001, p. 28). However, the push to encourage the study of science in senior secondary school and university was also about a particular view of economic development. Science and technology were seen as essential to a country’s manufacturing industry and this was a period in which the link between science and the military was tangible.

In these countries the 1980s saw the development of several creative curriculum responses to the sheer number of new students entering secondary education and continuing through to the senior years of study. While the provision of an educated scientific workforce remained a priority, there was also a belief that the majority of students who would not go on to study science in the senior years should be provided with a course that was appropriate to their present and future needs in the compulsory years of schooling (Fensham, 1985, 2000, 2002). Debate about the appropriate balance between the needs of the future ‘layperson’ and the future scientist, as well as what constitutes an appropriate form of science education for both of these groups continues today (Roberts, 2007).
In the 1990s the diversity of local responses was replaced by a uniformity of approach as jurisdictions adopted outcomes-based formulations of curricula. The expression of curriculum – not just science curriculum – in terms of outcomes, competencies and benchmarks has been perhaps the most noticeable trend since the mid 1990s. This trend has been seen throughout the Anglophone world: examples include successive UK National Curriculums, the National Science Education Standards from the (US) National Academy of Science (National Research Council, 1996), Benchmarks for Scientific Literacy (American Association for the Advancement of Science, 1993), National Statements and Profiles (Australian Education Council, 1994) and the Curriculum and Standards Framework for Science (Board of Studies, 1995). Gradual establishment of extensive centrally mandated national and international testing accompanied the move. A significant feature of this formulation has been the prescription of science teaching in the primary years, with codification and assessment of students’ science learning at levels that have, in the past, been at the discretion of the school or the individual teacher. An attendant consequence of this prescription has been that concern over student engagement with science and the quality of science teaching has been extended into the primary years of schooling.

Perhaps the most significant consequence of an outcomes-based approach is the limitation it has forced on available models for curriculum design and development. Given the expressed dissatisfaction with science education today, it is worth exploring why this form has become so dominant and what impact it may be having on our capacity to develop more engaging and inclusive courses.

The impact of social change on science curriculum
Most advocates for science curriculum change over the past decades have called for reform as a response to societal changes. For example, Hurd, writing about scientific literacy, cites ‘revolutionary changes’ (1998, pp. 408-409) such as the emergence of an information age, the birth of a global economy and the cyberworld. He reminds us of changes in how science is done; these include: science/technology is done by teams rather than a single researcher, science is increasingly interdisciplinary, scientific research has largely shifted from universities to industry and funding of science/technology is increasingly targeted according to social or economic priorities (1998, pp. 409-410). Tytler (2007) suggests that the crisis in science education can be put down to such societal changes as: a changing practice of science; the changing nature of public engagement with science; public challenges to the status of scientific knowledge arising from post-modern critiques of science; the knowledge explosion and attendant alterations in the nature of schooling; changing nature of youth and a changing population of students. Hurd’s concern is to ‘close the gap between academic science and science for the citizen’ (1998, p. 414) in order to ‘prepare students as productive citizens in today’s world’ (1998, p. 407); Tytler describes a crisis in science itself and an attendant failure of school science to engage students as he calls for a ‘re-imagined’ science curriculum.

These are evidences of change but the revolutionary changes in society over the past two or three decades have happened at a much deeper level. To understand their impact on science education one has to look for change over a wider field than science itself. Aikenhead’s (2006) analysis adopts a more powerful and ultimately more fruitful perspective because it locates science curriculum and science education at a different level in a complex web of inter-relationships and societal pressures:
An education jurisdiction’s decision on what knowledge is of most worth arises from a number of historical, social, cultural and political forces. This chapter’s synthesis of research into these forces did not produce a simple image of curriculum policy development but rather an interactively dynamic complex of individuals who unconsciously or purposefully represented a variety of institutional stakeholders, including students, teachers, other employees of school systems, parents, community employers, university science/engineering professors and registrar offices, university science educators/researchers, professional scientific organizations and institutes, teachers’ professional organizations, spokespersons for national businesses and industries, and government bureaucrats. Some are close to science classrooms. Some represent social structures in which classrooms are expected to operate. Others are far removed from current classroom life. Understandably, each has different self-interests. The ideology to exert the most power over curriculum policy will be the ideology most forcefully asserted in meetings of curriculum decision making. The simple ideology of preprofessional training of scientists and engineers seems to have political advantages over more complex ideologies that inspire humanistic approaches to school science (pp. 52-53).

In the UK, Canada and Australia today we live in a postmodern neo-liberal environment that has deeply disturbed most of the beliefs we held in the 1970s and 1980s about the relationships between individuals and their communities. The shift goes deeper than party politics: marketisation has come to be seen as the natural order of things (see, for example, critiques by Ball, 2006; Marginson, 1993; Seddon, Angus, & Brown, 1998; Yeatman, 2000b).
Critiques by Apple (2004, 2006) suggest that the USA also faces a strongly marketised education system.

Apple identifies two connected strategies that drive education policy in many nations: ‘neo-liberal inspired market proposals and neo-liberal, neo-conservative, and middle class managerial inspired regulatory proposals’ (2004, p. 13). Neo-liberalism is committed to the primacy of the free market, to freedom from government constraint, and an attendant drastic reduction of government responsibility for the provision of public services such as education. That this set of priorities should facilitate a strong state-mandated curriculum – or indeed any strong state structure - makes no sense unless the curriculum is seen as a mechanism for allowing competitive comparisons to be made; for this to be possible that curriculum must be expressed in terms of standards and benchmarks and must be accompanied by large scale testing:

… paradoxically … a national curriculum and especially a national testing program are the first and most essential steps toward increased marketization. They actually provide the mechanisms for comparative data that “consumers” need to make markets work as markets (Apple, 2004, p. 31).

While this may explain the shift to the forms of science curriculum we have seen since the 1990s, it does not explain why the content of these documents seems so committed to canonical science. In order to understand this, we need to understand the commitments of another group powerful today: ‘neo-conservative intellectuals who want a “return” to higher standards and a “common culture”’ (2004, p. 15):
In all too many countries, neo-liberal visions of quasi markets are usually accompanied by neo-conservative pressure to regulate content and behavior through such things as national curricula, national standards, and national systems of assessment. The combination is historically contingent; that is, it is not absolutely necessary that the two emphases are combined. But there are characteristics of neo-liberalism that make it more likely that an emphasis on the weak state and a faith in markets will cohere with an emphasis on the strong state and a commitment to regulating knowledge, values, and the body (Apple, 2004, p. 23).

Neo-liberalism impacts on science education because it has altered how we see science and how we see education (see Smith, 2006 for more detail on this point, of which a brief account follows). Firstly, the primacy it accords the market denies the social location of other institutions, including the institutions of science. Despite decades of scholarship to illustrate and elaborate the social context of science, in a neo-liberal view science is seen as isolated from society. This separation facilitates the neo-conservative choice to prefer an account of science that pre-dates the scholarship of the 1960s and 1970s.

Secondly, neo-liberalism impacts at a profound level how we view the purpose, processes and value of public education. It does this by altering how we see society itself; in particular, neo-liberalism alters how we see individuals within society. In the neo-liberal schema individuals are only individuals:

The objective of the market liberals was to create the social conditions in which their particular brand of individualism would be universalised; in which
the democratic political citizen would be replaced by the individualist economic anti-citizen (Marginson, 1997, p. 103).

Internationally, the impact of neo-liberalism on public institutions such as education have been critiqued from a variety of theoretical perspectives (see, for example, Apple, 2004, 2006; Ball, 2006; Marginson, 1993; Seddon & Angus, 2000; Seddon, et al., 1998). A social theorist who has something different and particularly useful to offer here is Anna Yeatman (1997, 2000a). In contrast with most commentators who reject moves towards individualization in favour of collectivism, Yeatman offers a subtler analysis that discriminates between forms of individualism. Insisting that individualization might have some value, Yeatman argues against a return to the patrimonial societies of classical liberalism or Marxism. She points out that neo-liberalism privileges a particular form of individualism above all others by configuring society as a loose grouping of competitive contractual individuals, but that this configuration is not an accurate representation of the true state of affairs.

Yeatman draws attention to two theoretical errors in the neo-liberal schema: firstly, although neo-liberal theory treats individuals as free agents, in practice this freedom relies on their having status within society; secondly, the neo-liberal view is based on a series of false dichotomies, chief amongst them the false opposition of individual and community. Hence, the impact of a neo-liberal view is to allow individuals to deny responsibility for society while benefiting from it. Yeatman calls for a ‘new contractualism’ that recognizes that individual and community are two faces of a single relationship.

Importantly, Yeatman’s analysis is not purely theoretically motivated. She uses the framework of the new contractualism to identify a trend in the public sector towards this
new contractual approach (Yeatman, 2000a, 2000b). At the same time, she draws from these examples arguments about and recommendations for how contracts and relationships should be organised if they are to support a post-patrimonial democratic community.

Becoming a contractual individual cannot exempt a person from the claims of community. A corollary to this point of view is that we challenge the narrow framing of society beloved of the neo-liberals, whose rhetoric would see community restricted to individuals and their families. However, rather than subsume the individual within community, the new contractualism reframes the obligations of society to the individual. Rather than deny a person’s status as a contractual individual, society undertakes to provide for each citizen the support they need in order to behave as autonomous beings.

This undertaking has particular implications for those who intend to be specialists in some field that will have impact on the lives of others. Smith (2006) extended Yeatman’s analysis to specifically consider these implications, concluding that in this scheme, experts cannot expect lay people to show blind trust in their superior knowledge, as they might have in the past; neither should we expect that each individual citizen should acquire the knowledge and expertise to keep the experts ‘honest’ (as is the case in a competitive neo-liberal world whose motto is caveat emptor). Instead, responsibility falls on the expert (perhaps more usefully framed as the professional) to see support for the layperson as part of his or her role. This perspective has many implications for science education (see Smith, 2006; Smith & Gunstone, 2009 for further discussion).

The analysis I report below forms part of a larger study (Smith, 2006) that developed Yeatman’s theoretical perspective in the contexts of science and education to examine the social contract between scientists and society in the context of the post-patrimonial neo-
liberal thinking that dominates today, and to elaborate the implications of that contract for 
science education. The larger study analysed four curriculum documents from the Australian 
state of Victoria, two for Physics in the senior years of secondary school (Physical Science 
Study Committee, 1960; Victorian Curriculum and Assessment Board, 1991) and two for 
General Science (an integrated science program, typically the science offered up to Year 10 
in the education system of Australia). The wider analysis demonstrated significant alterations 
in how science was located within society; in the framing of individuals within community; in 
the nature, purposes and types of assessment and in the underpinning views of the purposes 
of education. It concluded that the education of future scientists should be significantly re-
conceptualised.

The enacted curriculum is a very different entity from the intended one, and a curriculum 
document cannot encapsulate the totality of an intended curriculum. Here, the curriculum 
documents serve as artefacts: they are a tangible evidence of policy and culture; or, rather, 
evidence of the interactions that take place as culture produces policy which then acts upon 
culture. I have chosen to examine the written form of curriculum documents because they 
constitute a potent expression of formal policy intent and can also convey, informally, the 
climate in which they are written. As Carr reminds us:

[T]he relationship between curriculum and society is always reciprocal. 
Curriculum questions about what to teach and how to teach it are a particular 
expression of political questions about which aspects of an existing form of 
social life ought to be reproduced. Conversely, political questions about how 
society ought to be changed and improved always give focus and direction to 
curriculum questions about what should be taught and learned. Curriculum
development and social change are thus indivisible parts of a single dialectical process through which curriculum and society are simultaneously reproduced and transformed. (Carr, 1993, p. 1)

For this reason, the analysis I provide below is, in many respects, unique to Australia, and Victoria. On the other hand, the analyses I have cited above – particularly those of Apple (2004, 2006) provide evidence that some conclusions may be drawn that have wider relevance. To facilitate judgment of the extent to which generalization is possible, I provide a brief context here.

**Curriculum centralization in Victoria**

All Australian states underwent a policy shift towards marketisation at various stages in the 1990s. While the precise details and times vary from state to state, Meadmore (2001) writes of “a crucial change in political values [that] overtook the whole [Australian] public sector, including education” and identifies education in Victoria as being the pace-setter in 1993 with a radical programme of top-down devolution.

Devolution of responsibility for administration and budgets to schools was accompanied by the re-establishment of a strongly controlled, centralised curriculum. In Victoria during the 1970s and 1980s, schools had been free to develop their own curriculum in Years Prep to 10 (the compulsory years of schooling), loosely based on advisory documents provided by the Victorian Ministry of Education. While such a situation may conjure a picture of anarchy and significant variation across a state, there was not a great deal of difference between schools in terms of the content of the science curriculum. What the freedom supported was innovation in terms of teaching methods: teachers in many schools collaborated together to develop innovative approaches to teaching; informal and formal special interest groups
flourished and the curriculum materials they produced frequently had a local flavour. The Science Framework P-10: Science for Every Student (I will call this document Frameworks from now on) was written in this climate; its successor The Curriculum and Standards Framework (CSF), was the means by which standardisation of both teaching methods and syllabus content was re-introduced in Victoria.

Below, I compare The Science Framework P – 10 (Malcolm, Cole, Hogendoorn, O'Keeffe, & Reid, 1987) with its successor, The Curriculum and Standards Framework for Science (Board of Studies, 1995). In keeping with the theoretical perspective of the new contractualism, the main focus in this comparison will be the manner in which each child is framed - or not framed - in a community, and the manner in which science is portrayed - or not portrayed - as an activity of people, and present day communities.

The Science Framework P-10

The Science Framework P-10 (Malcolm, et al., 1987) was produced from within the Curriculum Branch of the Victorian Ministry of Education. Although Frameworks was not mandatory, it was an influential document because it communicated what the policy makers regarded as important. While a document alone cannot change classroom practice, it can send a clear message what is valued. From its colourful cover with a photograph of a child, clearly out of doors, examining beakers of muddy water, to its choice of font, to its layout, to its language, this was a document that sent coherent signals: science in schools was not restricted to a classroom, science in schools was for all students and the science taught in a school should be appropriate to the needs of the local community. The authors clearly intended that the document should be read by a wide range of interest groups: they
identified (p. 4) eight groups who may have wanted to consult the document. Two of the
groups they identified were parents and students.

Frameworks identified four aspects that make up science and five propositions that
comprised a Science Platform. The four aspects were the three of Science, Technology and
Society combined with a fourth aspect of Personal Development. These four aspects were
presented as ‘Science is …’ statements: science is knowledge and skills, science is
technology, science is society and science is personal development. In choosing to assert that
‘Science is people – people who undertake scientific activity in laboratories, on oil rigs, in
forests, in the Antarctic; people who control science in our government and institutions;
people who use the results of science; and all of us whose lives are affected by science’ (p. 8),
Frameworks explicitly embedded science within the wider community. The authors asserted
the human dimension of science as follows:

Science is thinking, building, feeling, expressing, believing, resolving,
organising, enjoying. It is working in teams and working alone, gaining
confidence and developing abilities and approaches that are important in
many aspects of our lives. It is valuing, caring, being responsible, making
decisions and taking action (p. 8).

The message that both science the social activity and science as personal development
should be embedded in a community was further emphasised in the Science Platform: ‘a set
of values and principles which can guide curriculum development in science’ (p. 9). Five
propositions comprised this platform: the kind of science that was valued - Science for All;
the goals of science teaching – Science, Technology, Society and Personal Development; an
approach to learning and teaching – beginning from children’s perceptions; the role of
teachers – the importance of teacher development in curriculum development; and curriculum content – sampling scientific knowledge.

The Science Framework has the following to say about curriculum content:

> Any school can only teach a sample of all the knowledge, skills and experiences related to science. *The sample should vary from one school to another, depending on local resources, interests and needs.* (p. 35, emphasis added).

And about the criteria by which a science curriculum should be chosen:

> … there is not a single “best” answer, relevant to all Victorian schools, to the question of what knowledge is of most worth, and the list that might be compiled by a Statewide consensus would be too large.

Given that the science curriculum can only address a sample of worthwhile content, it is important that the sample be allowed to vary from school to school. This has advantages to the State because it broadens and strengthens our scientific resource: we are not confronted with an entire generation with the same “gaps” in their competence. *It has advantages in that it recognises variations in the educational needs of different communities and enables schools to design curricula according to local needs and available resources …* (p. 36, emphasis added).

For the writers of this document, both the science curriculum and the learner were seen in the context of their local community. This was stated explicitly for the science, and it was clear in the case of the learner because of the expectation that the community should help to select the content and design of the school’s science program: the immediate local community was seen as having a role in the science education of each child. The expectation
that students will learn in the context of a community was further reinforced with sections on co-operative learning (p.67), excursions (p.75) and throughout the section on assessment (pp.76-86). The responsibility of schools to their community is reinforced in the section on evaluation and planning - ‘Evaluation is part of the school’s responsibility to account to the school community and to establish the effectiveness and suitability of its programs’ (p.87) – in which it is confirmed that the school’s response to identified community needs should be the basis for program evaluation. Students were pictured as working and learning together ‘students work in small teams’ (op. cit.), and knowledge is gained in the context of group activity. In addition, this group of student learners is seen as working on aspects of science that are important to themselves as learners today and in the future. Finally, science itself is framed in both a global context and a local one.

The Curriculum and Standards Framework for Science (CSF)

The immediate successor to the Science Frameworks was The Curriculum and Standards Framework (CSF), which was published as a Victorian State Government response to The Australian National Statements and Profiles (Australian Education Council, 1994). Instead of statements and profiles, the CSF was written in terms of standards and outcomes. Neither Frameworks nor CSF constituted a mandated state syllabus: both were advisory documents and both documents recommended that teachers should choose their teaching methods to suit the needs of their class. A significant difference, however, is that the CSF expected the listed content to be taught to all students. The CSF came with a requirement for testing and reporting against each detailed standard: all government schools were provided with a computer package (Department of Education, 1996) against which student records were to be kept and from which reports would be written.

The first eight pages of the Science CSF document were devoted to statements about the overarching CSF structure and policy. These statements covered such matters as reporting, assessment procedures, inclusiveness, students with disabilities and impairments, students
for whom English is a second language, and the intended use of the document in primary schools and secondary schools. Assessment of student progress through the CSF was to be partly achieved through uniform statewide testing at Years 3 and 5, later extended into Year 7. The outcomes were specified solely in terms of science knowledge, and since it was this that was to be common to all schools, it was this that would be tested. However, as it turned out, state-wide testing only took place in English and Mathematics.

The Science CSF also characterised science using a ‘science is’ statement:

Science and its applications are part of everyday life. Science education develops students’ abilities to ask questions and find answers about the natural and physical world. It provides students with insights into the way science is applied, and how scientists work in the community, and it helps them to make informed decisions about scientific issues, careers and further study (Board of Studies, 1995, p.9).

The statement ‘Science is part of everyday life’ should be read in the context of the learning outcomes, which are a list of science content that might easily date from the 1950s (except for the inclusion of plate tectonics and DNA). Almost no outcome in the CSF involved an experimental technique. (The exception here was Level 7, which was only reached by students working well beyond the usual range). In addition, the ‘Science procedures and processes’ section of the CSF framed responsibility solely in terms of the quality of experimental technique. Although the CSF was adapted from the Australian National Statements and Profiles, items from the National Statements that involved science as a social activity were absent. In the CSF, science was largely a list of content and a few skills.
In contrast with Science Frameworks, which argued for choosing carefully and dealing in depth with science, the CSF insisted that all the content must ‘be covered’ (Board of Studies, 1995, p. 1). It did make one concession:

This structure is not a straitjacket. Some students will achieve earlier, some later. The levels are there to provide a framework for identifying intentions and achievements (Board of Studies, 1995, p.4).

**Market-liberal perspectives and outcomes based curriculum**

Perhaps the most vivid illustration of the shift in educational priorities in Victoria in the 1990s is in the implied scope and purposes of each curriculum. Frameworks’ approach developed the Victorian government policy of the time:

[Schools] can ensure that all young people receive an education which enables them to participate fully in society, to contribute to overcoming injustice and inequality, and to solve the problems of our society. So the Government’s fundamental expectation of schools is that they further the knowledge, understanding of young people to be able to:

(a) participate effectively in the life of a multicultural society;

(b) undertake worthwhile work; and

(c) play and active role in the processes through which our society is regulated and improved. (Ministry of Education, 1984, p. 12)

It situated its purpose in the education of the whole child:

Attitude development is an important part of any (science) course;

Emotional responses should be tempered with evidence and argument through an examination of possible options; (Malcolm, et al., 1987, p. 62)
The CSF also reflected its time and its purpose:

The Board recognises that the idea of curriculum encompasses many aspects of learning that are beyond the structure and range of the CSF. Underlying many of the learning skills, processes and understandings that are present in the CSF are more general attitudes, values and personal qualities such as perseverance, initiative, honesty, loyalty and creativity.

The Board acknowledges that the development of these attributes is among the most important goals of education. They are by their nature difficult to define with precision and even more difficult to measure. Moreover, many people would have legitimate qualms about attempting to lay down within a policy framework qualities that are essentially individual and intensely subjective. (Board of Studies, 1995, p. 7)

This is not to make a case for including personal qualities in a standards framework. It is, rather, to note that the form of the CSF constrained its scope, in contrast with Frameworks which explicitly included personal development as part of its science platform. In the transition, something was lost from the idea of curriculum.

Formulation of a curriculum in terms of standards and outcomes allows precision about what each child is expected to know, and when. Specifying clear outcomes and considering how their achievement will be assessed is an essential aspect of teaching and learning. For example, the PEEL Project (Baird & Mitchell, 1987), which had its origins in Victoria in the 1980s, amongst many other things, supported classroom teachers to consider exactly how they could tell if students had learned what they had intended them to learn; more recently, the idea of backwards curriculum design as proposed by Wiggins and McTighe (2005)
encourages teachers to plan their students’ learning experiences by thinking first about how the learning will be assessed.

The constraint of the CSF may have had to do with the expectation that the outcomes it specified would have to be centrally tested. For example, Au’s (2007) meta-analysis of 49 studies into high-stakes testing in the USA found that such testing does usually lead to content narrowing. On the other hand, Au also found that some tests supported expansion of curriculum content into the areas that were being tested. In other words, the testing associated with a centrally prescribed curriculum can be a means for a state to specify what it expects of its schools.

The usual case made for such an arrangement is that it offers certainty to parents and continuity of education for that minority of children who move from school to school. What is not addressed is whether the results of comparative testing are the best way for parents to choose between schools, rather than, for example, choosing on the basis of a different curriculum. Or, indeed, whether the needs of a transient minority should take precedence over those of the majority who may benefit from an education that is situated in their local context. Specifying clear outcomes focuses attention on what it is that students are expected to achieve, but it can distract attention away from the things that we no longer explicitly expect from them.

The historical co-incidence of the marketisation of education and the introduction of centrally mandated and assessed outcomes-based curriculum may have been merely a coincidence of timing. However, an outcomes-based approach facilitates certain aspects of the marketisation of education. For example, Angus has argued that outcomes based education ‘gives a false, or at least unduly simplistic, impression that education is a neutral process and
that educational problems can be brought under control by managerial means. Competencies are likely to be atomistic, reductionist and to misrepresent the complex reality and variability of education’ (Angus, 1994, p. 12). The presentation of an intended curriculum in this manner ‘shifts our attention away from teachers and students struggling to make sense of complex issues and different material, and instead concentrates our attention simply on what students are able to do at the end of the day’ (ibid).

Outcomes-based education lent itself ideally to the fragmentation of community that accompanied neo-liberal thought. While attitudes such as perseverance, initiative, honesty, loyalty and creativity may be located in an individual, and intensely subjective, they are developed within the context of a community. Since a school is an institution of the community, it is reasonable that the development in children of qualities such as these should fall within the legitimate scope of a school. It requires neo-liberal thought for a policy document to assert that these qualities are outside its scope because they are unmeasurable. It should have been possible to list qualities such as these, state that they are unmeasurable by the means used for other types of knowledge and skills, but important none the less.

As an example, Twenty First Century Science, (Millar, 2006) which addresses the need to provide intending scientists with the social literacy they will need in the future was written from within a structure of key stages and attainment targets, initiated by the official regulator of school curriculum and examinations in the UK, whose ‘aim was to explore a more flexible structure for the school science curriculum for students aged 15–16’ (p. 1504). This curriculum, which was developed by a team experienced in and committed to the ideas of the Public Understanding of Science includes outcomes associated with assessing risk and handling ethical issues in science (OCR, 2010). However, this is a curriculum written for the final stages of compulsory schooling that is not intended for every English school child, but one of several GCSE curricula – indeed the body that offers Twenty First Century Science also
offers a more traditional science curriculum. In addition, the UK standards at GCSE are rather loosely specified, because the detailed specification is the responsibility of the examination authority: in other words, some flexibility was available. While outcomes-based curriculum does not preclude innovation, it does not support it: there needs to be a wider framework of values and a coherent vision for what it is that the curriculum must achieve and it can be tricky to keep this in view amidst the distraction provided by lists of outcomes.

**Implications for Science education today**

I am not advocating an uncritical return to the Science Framework of 1985; this article is not intended as a reminder of a golden age. On the other hand it is worth remembering there are other ways to frame curriculum than those in ascendancy, and that it is possible to write a curriculum that incorporates current thinking about best practice in science pedagogy, that demonstrates the social embeddedness of science and that supports high levels of student and community engagement. The comparison between these documents provides a clear illustration that curriculum is socially negotiated; it drives home the paucity of market driven versions of community and the poor platform such visions provide for curriculum.

I began this article by writing of dissatisfaction with science education, citing calls that it be re-imagined: any re-imagining must begin not with the content of science curriculum but rather with a careful consideration of its forms. Curriculum writers must be able freely to access forms of curriculum that allow them to better situate science education in its social context, as an essential part of the education of the whole person, the whole citizen. To some extent the work has begun: the 1990s models of science curriculum that failed to engage students are being critically assessed and responses developed. The international comparative assessment program PISA has provided a significant impetus for a new wave of
science curriculum initiatives (Fensham, 2009), while the ongoing exploration of the range of meanings for scientific literacy continues to generate creative responses (See, for example, Bulte, 2007; Jorde, 2007; Roberts, 2007)

Implicitly or explicitly, curriculum documents specify what a community believes its young people should learn, how they should learn it – what account they should be given - and why- to what end. The manner in which they choose to do this conveys a strong message about how that community envisages its future. This has to do with politics and power, but as Blades (1994), Hart (2001) and Fensham (1998) have reminded us, curriculum has always been socially situated and negotiated.

The decades of market liberalism have dramatically altered our perception of individuals and community. We cannot, even if we wanted to, return to the patrimonial practices that made possible the science curricula of the 1950s and 60s – those were developed for the few and those few were educated in a climate that acknowledged the importance of public service. Our future intending scientists need more than canonical science if they are to operate successfully as scientists: they will need the skills to engage with the ordinary citizens they support. They will need to recognize that science is a social institution and to see the science they do in its social context even as they do it. This is a process that must begin in school, and if that is to happen our curriculum must support it.

References


